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HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, CO 80527-2400

| EXAMINER | |
|---|---|
| MONDT, JOHANNES P | |
| ART UNIT | PAPER NUMBER |
| 2826 | |

DATE MAILED: 12/04/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. 09/963,933 | Applicant(s) TRAN ET AL. | |
|---|---|---|---|
| | Examiner Johannes P Mondt | Art Unit 2826 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *29 August 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-12 and 18-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12 and 18-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Response to Amendment*

Amendment A filed 8/29/2002 and entered as Paper No. 5 forms the basis for this present office action. In said Amendment A Applicant canceled claims 13-17 and substantially amended claims 1, 7, and 12. Comments to Remarks by Applicant included in said Amendment A can be found below under "Response to Arguments".

### *Response to Arguments*

1. Applicant's arguments filed 8/29/2002 have been fully considered but they are not persuasive with regard to the art rejections, although amendment of claim 7 has removed objection to claim 7. With regard to the newly stated objection to claim 8 "second layer" has to be replaced with "data layer". With regard to traverse of the art rejections of claims 1-6 and 9-12: the substantial amendment of claim 1 renders said traverse moot: furthermore, as is well known, the reference layer in magneto-resistive sensors such as the one taught by Parkin (cf. columns 1-2 of "Background of the Invention") can either be pinned, or, in the alternative, be unpinned, in the latter case instead deriving its orientation by activation from the current supplied to the sensor for sensing the resistance of the layer, as witnessed by Lin (5,949,623). With regard to claims 18-22, the traverse by Applicant rests on the same distinction made by Applicant between "pinned" and "unpinned" reference layers and hence is not persuasive for the same reason.

### *Claim Objections*

2. ***Claim 8*** is objected to because of the following informalities: The phrase "second layer" (line 2) should be replaced by: "data layer". Appropriate correction is required.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. ***Claims 1-6 and 10-11*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) in view of Lin (5,949,623).

*Claim 1:* Parkin teaches (cf. front figure, Figure 4B, title and abstract, particularly, the second sentence) a magnetic memory device comprising:

a data layer 132 having a magnetization that can be oriented in first and second directions (cf. column 5, lines 60-65), and a synthetic ferrimagnet reference layer 118 (cf. column 5, line 64), the data and reference layers having different coercivities (cf. abstract, first sentence).

Parkin et al do not necessarily disclose said synthetic ferrimagnet reference layer to be unpinned; however, it is understood in the art of magnetic resonance that reference layers can generate the required transverse bias field, a generic function for all reference layers in all types of magnetic resonance sensors in the prior art as cited,

either by being pinned or by activation from the current supplied by the sensor for sensing the data layer's resistance, thus obviating the need for the additional energy expanded for the pinning (motivation). Combination of the inventions is easily accomplished through judicious selection of material in view of the required coercivity and the mere removal of the pinning layer. Success in implementing the combination can therefore be reasonably expected.

*Claim 2:* by inherency in the invention essentially taught by Parkin et al and Lin, the data layer has a higher coercivity than the reference layer.

*Claim 3:* 118 includes first and second ferromagnetic layers 200 and 225 (cf. column 6, 38-43) separated by a spacer layer 210 (cf. column 6, line 40), the first and second ferromagnetic layers having different coercivities (cf. column 6, lines 61-65).

*Claim 4:* the spacer layer 210 is taught to be formed of Ru (i.e., ruthenium) (cf. column 9, lines 7-8), the same as all three Examples in Applicant's specification, and Ru is a electrically conducting, "magnetically non-conducting" material in the nomenclature of Applicant.

*Claim 5:* the coercivity of the reference layer is determined by the thickness of the first and second ferromagnetic layers (cf. column 6, line 61 – column 7, line 2).

*Claim 6:* the magnetic moments of the first and second ferromagnetic layers substantially cancel out (cf. column 6, line 61 – column 7, line 2).

*Claim 10:* the device further comprises a spacer layer 120 (cf. column 5, lines 60-65 and abstract, first sentence) between the data and reference layers.

*Claim 11:* said spacer layer is a tunneling barrier layer (cf. abstract, first sentence).

2. ***Claims 7-8*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) in view of Dahlberg et al (6,166,539). With reference to the claim rejection of claim 1 in original form, Parkin teaches a data layer with magnetization that can be oriented in first and second directions, and a synthetic ferrimagnet reference layer of coercivity different from that of the data layer. Parkin also shows two conductive layers on the reference layer (first conductor layer 112 and second conductor layer 102), however, Parkin does not does not necessarily show an insulator layer on the first conductor; however, as shown for instance by Dahlberg et al (cf. column 8, line 62 – column 9, line 26, and front figure, numeral 213 for the insulation layer in between the cap layer 215/216 and conductor 212) it has long been taught in the art to provide an intermediate insulation layer in between the conductor for providing the current needed to orient the magnetization in the reference layer and the cap layer 112 in order to reduce the influence of temperature through ohmic heating on magnetization of said reference layer (claim 7), while, as equally standard in the art of magnetoresistive sensors both top and bottom conductive leads, mutually orthogonal, are provided such that one of said conductive leads is in contact with the data layer (claim 8). Because the invention by Parkin only pertains to a novel set of ferromagnetic layers and does not pertain to any alteration in the use of said layers, it would have been obvious to include the teachings in this regard by Dahlberg et al. The inventions are combinable, because

top and bottom conductive leads by dint have to be provided in any magneto-resistive sensor device including the device by Parkin, while the implementation of said current-carrying leads can be expected to be successful, given the standard nature of said conductive leads.

3. ***Claim 9*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) in view of Gallagher et al (5,640,343). As detailed above, claim 1 is anticipated by Parkin. Although Parkin teaches a first conductor 104 in contact with the data layer and a second conductor 102 in contact with the reference layer, Parkin does not necessarily teach the further limitation defined by claim 9 that said first and second conductors be orthogonal. However, for the purpose for maximizing space utilization and optimizing the independent directions in which the bit- and word- line actions can be performed, the data layer 24 as taught by Gallagher et al is in contact with a first conductor 5 (cf. Figs 1A-B) and a second conductor 3 is in contact with the reference layer 18 (cf. column 3, lines 45-57 and column 4, lines 6-24), the first and second conductors being orthogonal (cf. column 3, lines 51-53).

4. ***Claim 12*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,012) and Lin as applied to claim 1, and further in view of Monsma et al (6,269,018).

*Claim 12:* As detailed above, claim 1 is unpatentable over Parkin et al in view of Lin; but neither Parkin et al nor Lin necessarily teach the further limitation defined by

claim 12. However, Monsma et al teach a magnetic memory device (cf. title and abstract) in which both layers are free, so as to improve the write selectivity of the individual MTJ cells in an MRAM; see for instance abstract and column 4, lines 14-62. Motivation for combining the inventions stems from the validity of the above-stated purpose for any MTJ. Combinability follows from the simplicity of the modification involved, namely: replacing the pinned layer with a free layer. Reasonable expectation of success is justified by the independence of the process of building the two stacks pertaining to layers 118 and 132 in Parkin.

5. ***Claims 18 and 20-22*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin (5,966,01), in view of Lin (5,949,623), Monsma et al (6,269,018) and Gallagher et al (5,640,343).

*Claim 18:* as detailed above, Parkin, in view of Lin and Monsma et al, renders unpatentable a memory cell including a data layer and soft ferrimagnet reference layer, both being "free", i.e., both data and reference layers have magnetizations that can be switched between first and second directions during write operations as both word and bit lines are involved (cf. column 3, lines 22-24). Furthermore, the reference ("second") layer is being switchable during reading operations through passing a current through sense or access line 104. None of the above cited two references necessarily teach the further limitation that "only" the second layer be so switchable, however: evidently one is enough, and hence, for reasons of economy, two would be a waste. None of the above-cited two references necessarily teach an information storage device comprising an

array of such memory cells as described above. However, an information storage device comprising an array is an obvious application of the single memory cell, as is evidenced by Gallagher et al. Gallagher et al teach an MTJ (magnetic tunneling junction) array as a non-volatile magnetic random access memory (MRAM) device (cf. title, abstract, and Figures 1A-B). Said application is obvious in view of the very purpose for which the single memory cell is designed, namely the combination of many in an array. Therefore, there is obvious motivation to combine the inventions, and reasonable success of doing so is ensured by the mature nature of the art of making MRAM devices.

*Claim 20 (and with reference to Parkin as well as the previous discussion of claims 5, 6 and 11):* the coercivity of the reference layer is determined by the thickness of the first and second ferromagnetic layers (cf. column 6, line 61 – column 7, line 2).

*Claim 21:* the magnetic moments of the first and second ferromagnetic layers substantially cancel out (cf. column 6, line 61 – column 7, line 2).

*Claim 22:* the device further comprises a spacer layer 120 (cf. column 5, lines 60-65 and abstract, first sentence) between the data and reference layers, said spacer layer being a magnetic tunneling barrier layer (cf. abstract, first sentence), and thereby a magnetic tunneling junction exists in every memory cell.

6. ***Claim 19*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Parkin, Lin, Gallagher et al and Monsma et al as applied to claim 18 above, and further in view of Gurney et al (5,408,377). As detailed above, claim 18 is unpatentable over Parkin in

view of Lin, Monsma and Gallagher et al. Neither Parkin, nor Gallagher et al nor Monsma et al necessarily teach the further limitation defined by claim 19. However, non-magnetic, electrically conductive spacer layers between two ferromagnetic layers, wherein the spacer layers serve to bring about a configuration in which the GMR can be exploited, and wherein only one of the ferromagnetic layers is enabled to freely rotate, has long been practiced in the art of magnetic recording, i.e., magnetic memory devices, as evidenced by Gurney et al, who teach free 70 and pinned 77 ferromagnetic layers (cf. column 5, lines 46 and 66, resp.) separated by a non-magnetic, electrically conducting spacer (Cu layer 65) (cf. Figure 6).

***Conclusion***

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Lai et al (US 2001/0012187 A1).

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

JPM
November 26, 2002